

CLAIMS

What is claimed is:

1. A method of producing high pressure hydrogen on-demand comprising:
providing a hydrogen feedstock at a high pressure;
5 providing water at a high pressure;
heating the hydrogen feedstock and water; and
placing the hydrogen feedstock and water into a catalytic reformer, wherein the
hydrogen feedstock and water are exposed to a catalyst in the reformer under
high pressure conditions.
- 10 2. The method of claim 1, wherein the hydrogen feedstock is natural gas.
3. The method of claim 1, wherein the hydrogen feedstock is methanol.
4. The method of claim 1, wherein the hydrogen feedstock is methane.
5. The method of claim 1, wherein the hydrogen feedstock is ethanol.
6. The method of claim 1, wherein the hydrocarbon feedstock is propane.
- 15 7. The method of claim 1, wherein the hydrogen feedstock is butane.
8. The method of claim 1, wherein the hydrogen feedstock is naphtha or
gasoline.
9. The method of claim 1, wherein the hydrogen feedstock is ammonia.

10. The method of claim 1, wherein the hydrogen feedstock is military-specification turbine fuel, commercial turbine fuel, diesel fuel, kerosene, or fuel oil.
11. The method of claim 1, wherein the hydrogen feedstock is natural gas condensate liquids or natural gasoline.
- 5 12. The method of claim 1, further comprising maintaining a pressure in the catalytic reformer in the range of 2,000 to 12,000 psi.
13. The method of claim 1, further comprising maintaining a pressure in the catalytic reformer in the range of 3,200 to 12,000 psi.
14. The method of claim 1, further comprising maintaining a pressure in the
10 catalytic reformer to be greater than 3,200 psi.
15. The method of claim 1, further comprising maintaining a temperature in the catalytic reformer in the range of 375° to 640° Celsius.
16. The method of claim 1, further comprising:
maintaining a pressure in the catalytic reformer in the range of 2,000 to 12,000 psi;
15 and maintaining a temperature in the catalytic reformer in the range of 375° to 640° Celsius.
17. The method of claim 1, further comprising separating hydrogen from other reformer output gases.
18. The method of claim 17, wherein carbon dioxide and water are separated from
20 hydrogen using a condenser.

19. The method of claim 1, wherein carbon dioxide is separated and recovered for sequestration or other utilization option.
20. The method of claim 1, further comprising using produced hydrogen to power a fuel cell.
- 5 21. The method of claim 20, further comprising using heat generated by the fuel cell to heat the catalytic reformer.
22. An apparatus for producing high pressure hydrogen comprising:
a preheater for heating a mixture of high pressure hydrogen feedstock and high
pressure water;
- 10 a catalytic reformer for receiving the preheated mixture and for facilitating the exposure of the mixture to a catalyst under high pressure conditions to produce hydrogen and other products; and
a condenser for separating the generated hydrogen from the other products.
23. The apparatus of claim 22, wherein the hydrogen feedstock is natural gas.
- 15 24. The apparatus of claim 22, wherein the hydrogen feedstock is methanol.
25. The apparatus of claim 22, wherein the hydrogen feedstock is comprised of one of methane, ethanol, propane, butane, naphtha, gasoline, ammonia, military-specification turbine fuel, commercial turbine fuel, diesel fuel, fuel oil, kerosene, natural gas condensate liquids, and natural gasoline.
- 20 26. The apparatus of claim 22, wherein the hydrocarbon fuel is comprised of a combination of one or more of natural gas, methanol, methane, ethanol, propane,

butane, naphtha, gasoline, ammonia, military-specification turbine fuel, commercial turbine fuel, diesel fuel, kerosene, fuel oil, natural gas condensate liquids, and natural gasoline.

27. The apparatus of claim 22, wherein the catalytic reformer is configured to
5 maintain a pressure in the range of 2,000 to 12,000 psi.

28. The apparatus of claim 22, wherein the catalytic reformer is configured to maintain a pressure in the range of 3,200 to 12,000 psi.

29. The apparatus of claim 22, wherein the catalytic reformer is configured to maintain a pressure greater than 3,200 psi.

10 30. The apparatus of claim 22, wherein the catalytic reformer is configured to maintain a temperature in the range of 375° to 640° Celsius.

31. The apparatus of claim 22, wherein the catalytic reformer is configured to maintain a pressure in the range of 2,000 to 12,000 psi and a temperature in the range of 375° to 640° Celsius.

15 32. The apparatus of claim 22, wherein hydrogen and carbon dioxide are produced, and wherein the carbon dioxide is recovered for sequestration or other utilization option.

33. The apparatus of claim 22, further comprising a fuel cell powered by the produced hydrogen.

34. The apparatus of claim 33, wherein the fuel cell is operatively coupled to the catalytic reformer to provide heat to the catalytic reformer.

35. A method of producing high pressure hydrogen comprising:
injecting high pressure water and a high pressure hydrogen carrier into a catalytic
5 reformer;

configuring the catalytic reformer to facilitate a reaction temperature in the range of
375 to 640 degrees Celsius and a reaction pressure in the range of 2,000 to
12,000 psi to facilitate the generation of hydrogen and other gases; and
separating the generated hydrogen from the other reformer output gases.

10 36. The method of claim 35, wherein the hydrogen carrier is natural gas.

37. The method of claim 35, wherein the hydrogen carrier is methanol.

38. The method of claim 35, wherein the hydrogen feedstock is comprised of a
combination of one or more of methane, ethanol, propane, butane, naphtha, gasoline,
ammonia, military-specification turbine fuel, commercial turbine fuel, diesel fuel,
15 kerosene, fuel oil, natural gas condensate liquids, and natural gasoline.

39. The method of claim 35, further comprising heating the water and hydrogen
carrier prior to the injection into the catalytic reformer.

40. The method of claim 35, wherein the generated hydrogen is used to power a
fuel cell, the method further comprising using heat generated by the fuel cell to heat
20 the catalytic reformer.

41. The method of claim 35, wherein hydrogen and carbon dioxide are produced, the method further comprising recovering the carbon dioxide for sequestration or other utilization option.

42. A method of producing high pressure hydrogen comprising:

5 heating a mixture of water and hydrogen feedstock;

exposing the mixture to a catalyst under high pressure, moderate temperature

conditions to create one or more products, including hydrogen; and

using a condenser to at least partially separate hydrogen from the other products.

43. The method of claim 42, wherein the hydrogen feedstock is natural gas.

10 44. The method of claim 42, wherein the hydrogen feedstock is methanol.

45. The method of claim 42, wherein the hydrogen feedstock is comprised of a combination of one or more of natural gas, methanol, methane, ethanol, propane, butane, naphtha, gasoline, ammonia, military-specification turbine fuel, commercial turbine fuel, diesel fuel, kerosene, fuel oil, natural gas condensate liquids, and natural
15 gasoline.

46. The method of claim 42, wherein the mixture is exposed to the catalyst under a temperature in the range of 375° to 640° Celsius.

47. The method of claim 42, wherein the mixture is exposed to the catalyst at a pressure in the range of 2,000 to 12,000 psi.

20 48. The method of claim 42, wherein the mixture is exposed to the catalyst at a pressure in the range of 3,200 to 12,000 psi.

49. The method of claim 42, wherein the mixture is exposed to the catalyst at a pressure greater than 3,200 psi.

50. The method of claim 42, wherein the mixture is exposed to the catalyst under a temperature in the range of 375° to 640° Celsius and at a pressure in the range of
5 2,000 to 12,000 psi.

51. A method of producing hydrogen comprising:
providing a mixture of a hydrogen feedstock and water; and
exposing the mixture to a catalyst in a catalytic reformer, wherein the temperature in
the reformer is in the range of 375° to 640° Celsius, and the pressure in the
10 reformer is in the range of 3,200 to 12,000 psi.